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CHAPTER 4 DESIGN STANDARDS

4.1 Purpose and Scope

This chapter provides detailed information on munitions facilities design standards for 21 munitions-related civil engineering (CE) real property category codes (Cat Codes). It is broken down into four sections corresponding to the major facility classes: Maintenance, Storage, Transportation, and Administration.

For most of the Cat Codes in this document, a description of the facility is provided along with overall design requirements. This is followed by facility-specific requirements under the following five categories:

1. Construction
2. Spatial Requirements
3. Mechanical Requirements
4. Electrical Requirements
5. Other Specific Requirements

To aid designers when preparing designs for munitions facilities projects, this chapter contains "best in class" design examples from selected Air Force installations for each Cat Code (where available). Department of Defense Explosives Safety Board (DDESB)-approved facility designs are noted on the design examples. For requirements common to munitions facilities, such as security and communications requirements, please refer to Chapter 3, "General Design Guidance".

AFH 32-1084, *Facility Requirements*, is the Air Force's handbook for determining spatial and other physical requirements for common Air Force facilities. **AFH 32-1084** provides guidance on 18 of the 21 munitions facilities addressed in this munitions design standard. The three facilities not included in AFH 32-1084 are:

- Category Code 422-253 – Multi-cubicle Magazine Storage
- Category Code 422-257 – Segregated Magazine Storage
- Category Code 610-144 – Munitions Administration Facility

AFMAN 91-201, *Explosives Safety Standards*, is the Air Force's primary source document for explosives safety criteria. Other Air Force requirements and guidance documents that provide munitions facilities criteria are listed in Chapter 5, "References, Abbreviations, Acronyms, and Terms", of this document and are identified in the discussion of each facility type in this chapter.

4.1.1 Maintenance Facilities

171-875 Munitions Loading Crew Training Facility

212-212 Missile Assembly Shop/Integrated Maintenance Facility (IMF)

212-213 Tactical Missile/Glide Weapons Maintenance Shop

215-552 Weapons and Release Systems Shop

215-582 Surveillance and Inspection Shop

216-642 Conventional Munitions Shop

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4.1.2 Storage Facilities

422-253 Multi-cubicle Magazine Storage

422-256 Rocket Check Out and Assembly Storage

422-257 Segregated Magazine Storage

422-258 Above- Ground Magazine Storage

422-264 Storage Igloo (Earth-covered Magazine)

422-265 Inert Spares Storage

422-271 Module Barricaded Storage

422-275 Ancillary Explosives Facility (Classification Yard, Holding Yard, Inspection Station, Interchange Yard, Loading Dock, Ready Explosive Facility, and Bomb Preload Station/Munitions Assembly Conveyor (MAC) pad)

4.1.3 Transportation Facilities

116-662 Pad, Dangerous Cargo

422-277 Flight Line Munitions Holding Point

851-147 Roads (Streets) – Primary and Alternate Explosives Movement Routes

Basic Design Standards for Munitions Maintenance Facilities

- **AFH 32-1084**, *Facility Requirements*
- **AFI 32-1021**, *Planning and Programming Military Construction (MILCON) Projects*
- **AFMAN 91-201**, *Explosives Safety Standards*
- **TM 5-1300/AFM 88-22**, *Structures to Resist the Effects of Accidental Explosives*
- **DoD 5100.76-M**, *Physical Security of Sensitive Conventional Arms, Ammunition and Explosives*
- **DoD 6055.9-STD**, *Ammunition and Explosives Safety Standard*
- **AFJMAN 32-8008, Vol 1**, *General Provisions for Airfield/Heliport Pavement Design*
- **DoD 4500.9-R Regulation**, *Defense Transportation Regulation (DTR) Part II*
- **UFC-3-260-01**, *Airfield and Heliport Planning and Design.*
- **Mil HDBK 1013/1A**, *Design Guidelines for Physical Security of Facilities*
- **Technical Order** (T.O.) 11A-1-61-4, and pertinent technical orders of the 11A, 11C, 11G, 11K, 11N, and

852-261 Vehicle Parking Operations – Used for Munitions Sub Pool Parking

890-158 Load and Unload Platform (Railhead) – Used for Munitions Operations

4.1.4 Administration Facilities

610-144 Munitions Administration Facility

4.2 Maintenance Facilities

Munitions maintenance facilities provide for the assembly, repair, configuration changes, inspection, corrosion control, and other tasks involving conventional munitions. They are not authorized for storage of munitions assets except for temporary storage of operational quantities to meet mission requirements.

When designing munitions maintenance facilities, concurrent explosives operations or dissimilar activities (which may require stand-off distances or substantial dividing walls) need to be evaluated. These activities may occur within the same building at the discretion of the Major Command (MAJCOM)/SEW. The criteria for these activities may vary by MAJCOM. Check with the base Weapons Safety Manager (WSM) in the early phase of facility planning for this determination.

4.2.1 Category Code 171-875 Munitions Loading Crew Training Facility

This facility is used for munitions loading crew training. Munitions loading crews use this facility to acquire and maintain proficiency on assigned weapon system(s). Classroom space is required to teach the academic portion of activities related to equipment operation, munitions safety attributes, and aircraft loading. Restrooms and a break area are authorized for this facility.

The loading crew training facility is usually located adjacent to the flight line. It may require explosives siting if the facility falls within the arc of the combat aircraft parking area. If outside the explosives clear zone, the facility may require an explosives license if aircraft explosives components are stored within the facility. Where space is limited, the classroom training may be separated from the aircraft-related training area. Similar types of aircraft training functions should be located in a consolidated facility whenever possible.

4.2.1.1 Facility-Specific Construction Requirements

Not applicable.

4.2.1.2 Facility-Specific Spatial Requirements

The training facility is a combination of classroom and open/covered/hangar space for training on static aircraft.

Figure 4.1
Munitions Load Crew Training Facility - Luke AFB, AZ

1. Classroom space requirements are based on projected student loads and are determined using AFH 32-1084. Additional classroom space may be allocated for training aids, mockups, and static display munitions.
2. Aircraft-related training should be conducted outdoors, if possible, to duplicate operational conditions to the maximum extent possible. Where environmental factors adversely impact outdoor training, provide a covered area or interior hangar space appropriate for the training operation. Adequate space for aircraft movement, storage and handling of training aids, support equipment, and inert munitions training items must be included in the hands-on training area.

4.2.1.3 Facility-Specific Mechanical Requirements

Heating, ventilation, and air conditioning (HVAC) requirements for office and classroom areas must comply with requirements defined in Chapter 3, “General Design Guidance.”

4.2.1.4 Facility-Specific Electrical Requirements

1. Provide convenience outlets to support computers, audiovisual equipment, break areas, and other usual and customary equipment associated with administrative and classroom training areas as described in **TM 5-811**, *Electrical Design, Interior Electrical System,* and **AFMAN 91-201**.
2. If facility is explosives sited or licensed, provide grounding, surge protection, and a lightning protection system (LPS).

Figure 4.2
Munitions Load Crew Training Facility - Cannon AFB, NM

4.2.1.5 Other Specific Requirements

If located within the explosives clear zone, the facility must be included in the explosives site plan (ESP). If located outside the explosives clear zone and explosives items are removed from the system and stored in the facility, an explosives license is required. **DoD 6055.9 STD**, *DoD Ammunition and Explosives Safety Standards,* and **AFMAN 91-201** outline explosives safety and siting/licensing requirements.

Figure 4.3
IMF -
Barksdale AFB, LA

4.2.2
Category Code 212-212
Missile Assembly Shop/Integrated Maintenance Facility (IMF)

This facility is used to prepare and transfer standoff missiles for operational use, organizational maintenance of components and subsystem replacement, and bench-level maintenance support for missile components. It also supports electrical testing and the evaluation of individual missiles and empty/loaded launcher systems. Restrooms and break area are typically included in this facility.

Functions performed in this facility require drive-through maintenance bays. Drive through work bays should have a smooth approach and apron area. The vehicle circulation layout within the munitions storage area (MSA) should provide easy access to and from this building.

4.2.2.1 Facility-Specific Construction Requirements

1. Interior dividing walls should be a minimum of 12 inches (in) (300 millimeter (mm)) thick reinforced concrete. Dividing walls between operating bays should have a compressive strength of 2,500 pounds per square inch gauge (psig) (17,170 kilo Pascals (kPa)). See **TM 5-1300/AFM 88-22**, *Structures to Resist the Effects of Accidental Explosions,* for more information on constructing substantial dividing walls.

   Check with the base WSM in the early phase of facility planning and requirements in **AFMAN 91-201** for concurrent operations interpretations by the MAJCOMs.

2. Maintenance bay floors should be of sufficient compression strength to accommodate missile system and related support equipment.

4.2.2.2 Facility-Specific Spatial Requirements

1. Space requirements for each weapon system are unique and are determined during the weapon system acquisition process.
2. Provide space for a hydraulic power unit as required for the type of weapon system assembled and maintained in the facility.

Figure 4.4
IMF Work Bay -
Barksdale AFB, LA

4.2.2.3 Facility-Specific Mechanical Requirements

Missile maintenance operations may generate fuel and solvent vapors that need to be removed from the facility. Size and capacity of the ventilation system will be determined in consultation with base Bio-Environmental. The ventilation requirements will be based upon function and operation of the facility.

1. Comply with fuel vapor emission criteria as required by **AFI 32-7040**, *Air Quality Compliance*.

2. HVAC requirements for office areas must comply with requirements defined in Chapter 3, "General Design Guidance."

4.2.2.4 Facility-Specific Electrical Requirements

1. Provide a back-up generator for uninterrupted power supply to allow continuous, explosives maintenance operations (e.g., missile testing, pylon loading, intrusion detection, etc.)
2. Provide grounding, surge protection, and LPS.
3. Provide explosion-proof lighting fixtures if facility is classified as a Class I explosive fuel/vapor hazard facility.
4. May require 120 volts alternating current (VAC), 400 Hertz (Hz), 3-phase power dependent on assigned missile systems as described in **TM 5-811** and **AFMAN 91-201**.

4.2.2.5 Other Specific Requirements

1. Provide overhead transverse-mounted hoist as required for the type of weapon system assembled and maintained in the facility.
2. Shops must have low-pressure air, 0 to 150 psig (0 to 1,030 kPa), and high-pressure air, 0 to 3,500 psig (0 to 24,100 kPa), in all bays.

4.2.3 Category Code 212-213 Tactical Missile/Glide Weapon Maintenance Shop

Figure 4.5
Tactical Missile/Glide Weapon Maintenance Shop -
Barksdale AFB, LA

Missile and glide munitions assembly and disassembly inspections, testing, and repairs are accomplished in this facility. The facility consists of individual drive-through work bays, a test cell room for electrical and resistance checks of rocket motors, a tool and test equipment support room, and a supply and equipment storage area. Restrooms and a break area are typically included in this facility. An administrative area for office space and a ready/training room are also included, but separated from the shop area by a substantial dividing wall. The drive-through work bays should have a smooth approach and apron area.

4.2.3.1 Facility-Specific Construction Requirements

Interior dividing walls should be a minimum of 12 in (300 mm) thick reinforced concrete. Dividing walls between operating bays should have a compressive strength of 2,500 psig (17,170 kPa). Propagation protection for other maintenance operations should be provided between operating bays as outlined for concurrent operations in **AFMAN 91-201** and **TM 5-1300/AFM 88-22**.

Figure 4.6
Tactical Missile/Glide Weapon Maintenance Shop -
Luke AFB, AZ

Check with the WSM in the early phase of facility planning for concurrent operations interpretations by the MAJCOMs that may inhibit the ability to perform multiple operations in a facility.

4.2.3.2 Facility-Specific Spatial Requirements

Separate facilities should be provided to support missiles involving different explosives hazards, (e.g. fragmentation, extreme heat, mass detoriation).

This facility requires a minimum of one work bay per assigned missile type. Each work bay is typically 30 feet (ft) x 50 ft (9.1 meter (m) x 15.2 m), depending upon workload. For example, a facility with three work bays could have one bay for air-to-air missile systems, one for air-to-ground missiles, and one for glide weapon systems.

An adjoining administrative area consists of about 1,500 square feet (sq ft) (137 meters squared (m^2)).

A test cell room may be required for rocket motor electrical and resistant checks.

4.2.3.3 Facility-Specific Mechanical Requirements

1. Provide a ventilated paint spray booth, if required.
2. Comply with fuel vapor and paint vapor criteria as required by **AFI 32-7040**.

Figure 4.7
Tactical Missile/Glide Weapon Maintenance Shop - Langley AFB, VA

3. Environmental controls for humidity and temperature are required to assure proper protection for weapon systems and test equipment.
4. HVAC requirements for office and bay areas must comply with requirements defined in Chapter 3, "General Design Guidance."

4.2.3.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. Shops must have 115 VAC, 60 Hz, single-phase and 115 VAC, 400 Hz, 3-phase electricity as described in **TM 5-811** and **AFMAN 91-201**.

4.2.3.5 Other Specific Requirements

1. Provide high security hasps on all bay doors with an intrusion detection system as required by **AFI 31-101**, *The Air Force Installation Security Program* (For Official Use Only (FOUO)).
2. The shop requires a 4,000-pound (lb) (1,810 kilogram (kg)) transverse-mounted hoist in each bay.
3. All bay doors are a minimum 10 ft (3 m) high and 17 ft (5 m) wide.
4. The shop may need a drive-through paint spray booth that complies with environmental standards.
5. Shops must have low-pressure air, 0 to 150 psig (0 to 1,030 kPa), and high-pressure air, 0 to 3,500 psig (0 to 24,100 kPa), in all bays.

Figure 4.8
Weapons and Release System Shop - Cannon AFB, NM

4.2.4 Category Code 215-552 Weapons and Release Systems Shop

Overhaul and repair of aircraft weapons release and gun systems including bomb racks, weapons pylons, ejection racks, aircraft gun systems are accomplished in this facility. The facility also includes a gun and/or ejector unit cleaning room, maintenance offices, a dispatch office, a bench stock room, and storage space for test equipment, alternate mission equipment (AME), spare gun systems, and mobility equipment. Restrooms and a break area are authorized for this facility.

4.2.4.1 Facility-Specific Construction Requirements

If supporting B-1 aircraft, floor must support 50,000 lb. (22,800 kg) with a 250 psig (1,720 kPa) tire footprint.

4.2.4.2 Facility-Specific Spatial Requirements

Figure 4.9
Weapons and Release System Shop - Luke AFB, AZ

1. The space requirement for aircraft not equipped with multiple ejector racks (MER) is 10,530 sq ft (980 m2).
2. The space requirement for aircraft equipped with MER is 11,500 sq ft (1,070 m^2).
3. The space required for 12 Primary Authorized Aircraft (PAA) B-52 units is 6,000 sq ft (550 m^2) and 5,000 sq ft (460 m^2) for each additional 12 PAA.
4. The space required for 12 PAA B-1 units is 5,000 sq ft (460 m^2) and 3,000 sq ft (275 m^2) for each additional 12 PAA.
5. For aircraft with gun systems installed, the shop requires a vault for gun maintenance and spare gun storage.
6. Allow 650 sq ft (60 m^2) for administrative space.
7. Additional space may be provided for the storage of mobility-support equipment in high-threat areas.
8. Provide space for storage of AME.

4.2.4.3 Facility-Specific Mechanical Requirements

1. Consult with base Bio-Environmental for the requirements to provide adequate ventilation for the weapons systems cleaning room.
2. Comply with emission criteria as required by **AFI 32-7040**, the Uniform Building Code (UBC), and **Occupational Safety and Health Administration (OSHA)** requirements.
3. HVAC requirements for office and bay areas must comply with requirements defined in Chapter 3, "General Design Guidance."

4.2.4.4 Facility-Specific Electrical Requirements

1. Provide 115 VAC, 60 Hz, single-phase and surge protection as described in **TM 5-811** and **AFMAN 91-201**.
2. Explosion-proof light fixtures may be required in the maintenance bays if a Class I (explosive fuel/vapor) or Class II (explosive dust) hazard will be encountered.
3. Consult the users for special electrical requirements of test equipment.
4. Provide grounding, surge protection, and LPS.

4.2.4.5 Other Specific Requirements

1. A 10-ton (9,070 kg) monorail hoist is required for facilities supporting B-52 aircraft tasked with heavy stores/MER beams and cluster racks.
2. For facilities supporting the B-1B aircraft, a 10-ton (9,070 kg) monorail hoist is required.
3. For facilities supporting B-1 aircraft, a minimum 12 ft x 12 ft (3.65 m x 3.65 m) overhead doors are required for drive-through bays.
4. If located within the explosives clear zone, the facility must be included in the explosives site plan. If located outside the explosives clear zone and explosives items are removed from the system and stored in the facility, an explosives license is required. **DoD 6055.9 STD** and **AFMAN 91-201** outline explosives safety and siting/licensing requirements.

4.2.5 Category Code 215-582 Surveillance and Inspection Shop

Figure 4.10
Surveillance and Inspection Shop -
Langley AFB, VA

This facility accommodates the initial assembly, inspection, test bench, and minor maintenance of various conventional and non-conventional munitions, and their respective components, to include electro-optical and laser-guided bomb guidance kits. Supervisory or administrative space is required for this facility. Restrooms and a break area are authorized for this facility.

4.2.5.1 Facility-Specific Construction Requirements

Interior dividing walls should be a minimum of 12 in (300 mm) thick reinforced concrete. Dividing walls between operating bays should have a compressive strength of 2,500 psig (17,170 kPa). Propagation protection for other surveillance and inspection operations should be provided between operating bays as outlined for concurrent operations in **AFMAN 91-201** and **TM 5-1300/AFM 88-22**.

Figure 4.11
Surveillance and Inspection Shop -
McChord AFB, WA

Check with the base WSM in the early phase of facility planning for concurrent operations interpretations by the MAJCOMs.

4.2.5.2 Facility-Specific Spatial Requirements

Space authorized is dependent on aircraft type assigned per **AFH 32-1084**.

1. Fighter aircraft require 3,940 sq ft (366 m^2).
2. Bomber aircraft require 2,090 sq ft (194 m^2).
3. Facility may have more than one work bay.

4.2.5.3 Facility-Specific Mechanical Requirements

1. HVAC requirements for office and bay areas must comply with requirements defined in Chapter 3, "General Design Guidance."
2. Comply with paint vapor criteria as required by **AFI 32-7040**, if a paint booth is to be installed.

4.2.5.4 Facility-Specific Electrical Requirements

1. Explosion-proof light fixtures may be required in the inspection bays if a Class I (explosive fuel/vapor) or Class II (explosive dust) hazard will be encountered.
2. 115 VAC, 400 Hz, 3-phase power may be required as described in **TM 5-811** and **AFMAN 91-201**.
3. Provide grounding, surge protection, and LPS.

4.2.5.5 Other Specific Requirements

1. Provide crane or hoist as required for the type of weapon systems assembled, maintained, and inspected in the facility. Cranes and hoists may require special safety devices to prevent ignition of explosive vapors and dust, if present.
2. Bay doors are a minimum 10 ft (3 m) high by 16 ft (4.8 m) wide.
3. Bay doors require high security hasps if an intrusion detection system (IDS) is installed.
4. Facility may need low-pressure air, 0-150 psig (0-1,030 kPa).
5. Facility may need a drive-through paint booth with an approved ventilation system.

4.2.6 Category Code 216-642 Conventional Munitions Maintenance Shop

Figure 4.12
Conventional Munitions Maintenance Shop - Cannon AFB, NM

This facility is used to perform maintenance operations including assembly, disassembly, corrosion control, testing and troubleshooting, repair, and time compliance technical orders (TCTO) on various munitions components and containers. It consists of multiple drive-through work bays, a tool room, training and ready room, office space, and restrooms. The vehicle traffic pattern within the MSA should provide easy access to and from this building.

4.2.6.1 Facility-Specific Construction Requirements

Interior dividing walls should be a minimum of 12 in (300 mm) thick reinforced concrete. Dividing walls between operating bays should have a compressive strength of 2,500 psig (17,170 kPa). Propagation protection for other maintenance operations should be provided between operating bays as outlined for concurrent operations in **AFMAN 91-201** and **TM 5-1300/AFM 88-22**.

Figure 4.13
Conventional Munitions Maintenance Shop - Luke AFB, AZ

Check with the base WSM in the early phase of facility planning for concurrent operations interpretations by the MAJCOMs.

4.2.6.2 Facility-Specific Spatial Requirements

1. The number of bays and bay dimensions are dependent on mission requirements. Usually a minimum of three, 30 ft x 50 ft (9.1 m by 15.2 m) drive-through work bays are required.
2. Space requirements for the adjoining office space must be in accordance with **AFH 32-1084**.
3. At the minimum, a tool room, training room, ready room, and restrooms should be included.

4.2.6.3 Facility-Specific Mechanical Requirements

HVAC requirements for office and bay areas must comply with requirements defined in Chapter 3, "General Design Guidance."

4.2.6.4 Facility-Specific Electrical Requirements

1. Provide 115 VAC, 60 Hz, single phase and 220 VAC, 60 Hz, 3 phase source as described in **TM 5-811** and **AFMAN 91-201**.
2. Provide grounding, surge protection, and LPS.

4.2.6.5 Other Specific Requirements

1. Provide high security hasps on all bay doors with IDS per **AFI 31-101**.

2. Bay doors must be a minimum of 10 ft (3 m) high and 16 ft (4.9 m) wide. Actual bay door sizes are dependent on the mission.
3. Provide a 4,000 lb (1,810 kg) transverse-mounted hoist in one bay.
4. Provide pressured air from 0 to 150 psig (0 to 1,030 kPa) in all work bays.

4.2.7 Category Code 218-712 Aircraft Support Equipment Shop/Storage Facility (Aerospace Ground Equipment (AGE) Facility) Used for Munitions Support Maintenance

Figure 4.14
Powered Trailer Facility - Barksdale AFB, LA

This facility is used for inspecting, maintaining, servicing, and repairing assigned powered and non-powered munitions materiel handling equipment (MMHE). Requirements for the number of munitions trailers maintained in the facility will vary depending upon the unit's mission. General guidance for aircraft support equipment shop/storage facility (AGE Facility) is found in **AFH 32-1084**. Restrooms and a break area are authorized for this facility.

4.2.7.1 Facility-Specific Construction Requirements

Office areas require sound attenuation.

4.2.7.2 Facility-Specific Spatial Requirements

1. Includes maintenance stalls with workbenches, a wash rack, tool crib, bench stock, office space, and personnel locker space.
2. An enclosed storage facility is authorized if powered munitions trailers are assigned to the installation. This facility should be near the support equipment maintenance shop to house equipment not in use. Space required is stated in **AFH 32-1084**.
3. Allow 230 sq yds (192 m^2) of space per authorized powered munitions trailer assigned to each facility.

Figure 4.15
Equipment Maintenance Facility - Langley AFB, VA

4.2.7.3 Facility-Specific Mechanical Requirements

1. A segregated and enclosed paint booth or facility is required to meet environmental requirements associated with sanding, brake work, corrosion control, and surface painting.
2. The paint booth area in this facility requires special ventilation and/or exhaust evacuation. Consult with base Bio-Environmental office for further guidance. All AGE facilities must comply with local, state and federal requirements for air emissions, as required in **AFI 32-7040**.
3. HVAC requirements for office areas must comply with requirements defined in Chapter 3, "General Design Guidance."

4.2.7.4 Facility-Specific Electrical Requirements

1. Provide 120 VAC, 60 Hz and 220 VAC, 60 Hz power as described in **TM 5-811** and **AFMAN 91-201**.
2. Additionally, 440 VAC power is required for powered trailers. The 440 VAC receptacles are required in sufficient quantities and copiously spaced to allow for the operation of powered trailers in and around the facility.

4.2.7.5 Other Specific Requirements

1. A 10-ton (9,070 kg) overhead hoist for trailer support equipment is required for powered trailers and a 5-ton (4,540 kg) hoist is required for non-powered trailers.
2. A wash rack with hot and cold water is required.
3. An oil-water separator is required for the wash rack. Refer to **MIL HDBK 1190**, *Facility Planning and Design Guide,* for oil-water separators servicing wash racks.
4. Air pressure from 0 to 120 psig (0 to 827 kPa) is required in all work bays.

Basic Design Standards for Munitions Storage Facilities

- **AFH 32-1084**, *Facility Requirements*
- **AFI 32-1021**, *Planning and Programming Military Construction (MILCON) Projects*
- **AFMAN 91-201**, *Explosive Safety Standards*
- **TM 5-1300/AFR 88-22**, *Structures to Resist the Effects of Accidental Explosives*
- **DoD 5100.76-M**, *Physical Security of Sensitive Conventional Arms, Ammunition and Explosives*
- **Mil HDBK 1013/1A**, *Design Guidelines for Physical Security of Facilities*
- **DoD 6055.9-STD**, *DoD Ammunition and Explosive Safety Standard*
- **Technical Order** (T.O.) 11A-1-61-4, and pertinent technical orders of the 11A, 11C, 11G, 11K, 11N, and 11P series

4.3 Munitions Storage Facilities

Munitions storage facilities are used to store munitions explosives materiel, inert components and equipment used for the operating requirements of the Air Force. **AFH 32-1084** contains definitions for category codes pertaining to storage facilities.

Munitions storage factors include, Q-D, location of existing storage facilities, Net Explosives Weight (NEW), hazard class/divisions, compatibility groups, physical size of items to be stored, unique security safeguards, and regulatory requirements as to type of facility and storage configuration.

The following are common criteria for munitions storage facilities.

1. The MSA is an area reserved exclusively for explosives storage, as defined in **AFMAN 91-201**. Inert spares storage facilities may be located outside the explosives clear zone. Also, the rocket check out and assembly storage facility may be licensed for explosives if located outside the MSA. Incoming vehicle inspection and interchange yards may not need explosives siting. AFMAN 91-201 contains details on explosives siting rules.
2. The proper placement of earth barricades around explosives storage facilities enhances the safety of personnel and protection of property. **AFMAN 91-201** contains details on earth barricade use and construction.
3. Where two or more commands operate from an installation, storage facilities should be integrated into a single MSA to the extent possible.
4. Depending on use, storage facilities may require electrical outlets and interior/exterior lighting.
5. Explosion-proof fixtures are required if there is a Class I (explosive vapor) or Class II (explosive dust) hazard present.
6. Munitions, materiel, and support equipment used for the operating requirements of the Air Force are kept in storage facilities under the responsibility of the using organization.
7. References relating to munitions storage facility planning are listed in the text box in the margin.
8. High security hasps are required on all facility doors protected by an intrusion detection system as required by **AFI 31-101**. Break-in resistance measures (e.g. reinforcement) are required for doors, exterior walls, and roofs.

4.3.1 Category Code 422-253 Multi-cubicle Magazine Storage

Figure 4.16
Multi-cubicle Magazine Storage -
McChord AFB, WA

Multi-cubicle magazines are a category of above-ground munitions storage magazines used to store small quantities of explosives. Because of their small size and separation of adjoining bays, they are ideal for segregating incompatible hazard classifications and explosives groups and for supporting munitions custody account customers. This facility may also be used to store combat-alert loaded munitions trailers and can be accessed with most munitions support equipment.

4.3.1.1 Facility-Specific Construction Requirements

Interior dividing walls should be a minimum of 12 in (300 mm) thick reinforced concrete. Dividing walls between storage bays should have a compressive strength of 2,500 psig (17,170 kPa). Propagation protection for other storage bays should be provided between bays as outlined for concurrent operations in **AFMAN 91-201** and **TM 5-1300/AFM 88-22**.

Figure 4.17
Multi-cubicle Magazine Storage –
Langley AFB, WA

4.3.1.2 Facility-Specific Spatial Requirements

Facility size and number of bays dependent upon mission requirements.

4.3.1.3 Facility-Specific Mechanical Requirements

May require HVAC for climate control depending on assets to be stored and local climate conditions.

4.3.1.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.

4.3.1.5 Other Specific Requirements

1. Doors must have high security hasps and may need an intrusion detection system per **AFI 31-101**.
2. Facility doors will be made of steel and may be hinged, sliding, or roll-up type.
3. Apron in front of doors must be large enough to permit safe operation of munitions support equipment.

4.3.2 Category Code 422-256 Rocket Check Out and Assembly Storage

Rocket check out and assembly storage facilities are unique in that they serve as an operating location to accommodate the assembly, disassembly, and electrical check out of rockets as well as providing a site to store built-up rockets. Since the addition of the MK-66 rocket motor in the inventory, electrical continuity checks of rocket motors are rare. This facility is now often used for other munitions operations (e.g., flare and chaff build-up, argon recharging, small bomb assembly, 20mm replenishing, etc.).

Rocket check out and assembly storage facilities located within the MSA shall be included on the explosives site plan. If located outside the MSA, an approved explosives license must be obtained. Restrooms may be appropriate if facility is used as an operating location.

4.3.2.1 Facility-Specific Construction Requirements

1. The facility will be constructed of concrete.
2. The 12 in (300 mm) thick reinforced concrete walls should have compression strength of 2,500 psig (17,167 kPa) and be positioned so the rockets face the reinforced walls during build-up operations and storage.

   Check with the base WSM in the early phase of facility planning for concurrent operations interpretations by the MAJCOMs.
3. Facility doors will be made of steel and must be a minimum of 3/8 in (9.5 mm) thick.

4.3.2.2 Facility-Specific Spatial Requirements

The complete facility contains 11,160 sq ft (1,040 m^2) including area for a field office, but size varies depending on mission requirements.

4.3.2.3 Facility-Specific Mechanical Requirements

May require HVAC for climate control depending on assets to be stored and local climate conditions.

4.3.2.4 Facility-Specific Electrical Requirements

1. May require electrical outlets and interior/exterior lighting.
2. Provide grounding, surge protection, and LPS.
3. Must have 120 VAC, 60 Hz, single-phase electricity as described in **TM 5-811** and **AFMAN 91-201**.

4.3.2.5 Other Specific Requirements

Doors must have high security hasps and may need an intrusion detection system per **AFI 31-101**.

4.3.3 Category Code 422-257 Segregated Magazine Storage

Figure 4.18
Segregated Magazine Storage -
Langley AFB, VA

Segregated magazines are a category of above-ground munitions storage magazines very similar to multi-cubicle magazines used to store small quantities of explosives. Because of their small size and separation of adjoining bays, they are ideal for segregating incompatible hazard classes and explosives groups and for supporting munitions custody account customers. Each cubicle in a segregated magazine is generally a small storage locker, with a door width not exceeding 36 in (914 mm), and is usually inaccessible by most munitions support equipment.

4.3.3.1 Facility-Specific Construction Requirements

Interior dividing walls should be a minimum of 12 in (300 mm) thick reinforced concrete. Dividing walls between storage bays should have a compressive strength of 2,500 psig (17,1170 kPa). Propagation protection for other storage bays should be provided between bays as outlined for concurrent operations in **AFMAN 91-201** and **TM 5-1300/AFM 88-22**.

Figure 4.19
Segregated Magazine Storage -
Luke AFB, AZ

4.3.3.2 Facility-Specific Spatial Requirements

Facility size and number of bays dependent upon mission requirements.

4.3.3.3 Facility-Specific Mechanical Requirements

May require HVAC for climate control depending on assets to be stored and local climate conditions.

4.3.3.4 Facility-Specific Electrical Requirements

Provide grounding, surge protection, and LPS.

May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.

Figure 4.20
Segregated Magazine Storage -
McChord AFB, WA

4.3.3.5 Other Specific Requirements

1. Doors must have high security hasps and may need an intrusion detection system per **AFI 31-101**.
2. Facility doors will be made of steel and may be hinged, sliding, or roll-up type.
3. Apron in front of doors must be large enough to permit safe operation of munitions support equipment.

4.3.4 Category Code 422-258 Above- Ground Magazine Storage

Figure 4.21
Above Ground Magazine Storage -
Cannon AFB, NM

Above- ground munitions storage magazines are used to store explosives. They do not afford the same degree of protection as an earth-covered magazine (ECM) and therefore require a greater Q-D to ensure the proper degree of protection for exposed sites and personnel.

4.3.4.1 Facility-Specific Construction Requirements

Above- ground magazines may be made of any type of non-combustible material (e.g., metal, concrete, clay tile, cinder block, etc.) or may even consist of just an open pad.

4.3.4.2 Facility-Specific Spatial Requirements

1. The magazines may vary in size from 1,800 sq ft to 10,000 sq ft (167 m^2 to 918 m^2) depending upon the volume of munitions to be stored.
2. Refer to Unit's Master Storage Plan, **DDESB TP-15**, *Approved Protective Construction (Version 1.0),* **DoD 6055.9-STD**, and **AFMAN 91-201** for further guidance on storage space requirements.

Figure 4.22
Above- Ground Magazine Storage -
Luke AFB, AZ

4.3.4.3 Facility-Specific Mechanical Requirements

May require HVAC for climate control depending on assets to be stored and local climate conditions.

4.3.4.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.

4.3.4.5 Other Specific Requirements

1. Doors require high security hasps and may need an intrusion detection system per **AFI 31-101**.
2. Facility doors will be made of steel and may be hinged, sliding, or roll-up type.
3. Apron in front of doors must be large enough to permit safe operation of munitions support equipment.

Figure 4.23
Storage Igloo - Luke AFB, AZ

4.3.5 Category Code 422-264 Storage Igloo

Storage igloos are the preferred facility type for the storage of all explosives. They are ECM's and are either of a concrete or steel arch-type construction.

4.3.5.1 Facility-Specific Construction Requirements

1. Igloos are covered with a minimum of 24 in (610 mm) of earth covering. The earth covering must not contain stones/rocks larger than 6 in (152 mm) in diameter or weighing more than 10 lbs (4.5 kg).
2. The Munitions Storage Module (MSM), a pre-engineered concrete panel design, features vertical walls and a flat roof to maximize storage space. A 26 ft (7.9 m) wide, 14 ft (4.2 m) high door adds efficiency to warehousing operations.

4.3.5.2 Facility-Specific Spatial Requirements

1. The typical length is 80 ft (25.3 m). Variable lengths, in increments of 20 ft (6.0 m), provide flexibility to meet mission requirements. The design has been approved by DDESB for siting igloos with a maximum NEW of 500,000 lbs (227,273 kg).
2. The steel arch earth-covered igloo has a concrete floor, foundations, side arches, and a rear and front wall. The typical length is 80 ft (25.3 m) although it may be constructed in variable lengths in 2 ft (0.6 m) increments and in widths up to 30 ft (9.1 m). The arch is constructed of heavy gauge corrugated steel plates. The double leaf doors are of heavy blast-resistant steel.

4.3.5.3 Facility-Specific Mechanical Requirements

May require HVAC for climate and humidity control depending on assets to be stored and local climate conditions.

4.3.5.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.

4.3.5.5 Other Specific Requirements

1. Doors require high security hasps and may need an intrusion detection system per **AFI 31-101**.
2. Facility doors will be made of blast-resistant steel and may be hinged or sliding type.

3. Apron in front of doors must be large enough to permit safe operation of munitions support equipment.
4. Assure adequate area and structural design of pads in front of facility.

4.3.6 Category Code 422-265 Inert Spares Storage

Figure 4.24
Inert Spaces Storage - Luke AFB, AZ

This building is used to store inert munitions components (e.g. inert bombs, fins, empty containers, chaff, lumber), materials, and support equipment (e.g., MMHE, AME).

4.3.6.1 Facility-Specific Construction Requirements

Inert storage facilities are made of any type of non-combustible material (e.g., metal, concrete, clay tile, cinder block, etc.) or may even consist of just an open pad.

4.3.6.2 Facility-Specific Spatial Requirements

1. Required floor space can be computed using the MSA's Unit Master Storage Plan.
2. Any facility may be used as an inert storage facility provided it meets Q-D requirements per **AFMAN 91-201.**

4.3.6.3 Facility-Specific Mechanical Requirements

Figure 4.25
Inert Spaces Storage - Langley AFB, VA

May require HVAC for climate and humidity control depending on assets to be stored and local climate conditions.

4.3.6.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.

4.3.6.5 Other Specific Requirements

1. Doors may require high security hasps and may need an intrusion detection system per **AFI 31-101**.
2. Facility doors will be made of steel and may be hinged, sliding, or roll-up type.
3. Apron in front of doors must be large enough to permit safe operation of munitions support equipment.

4.3.7 Category Code 422-271 Module Barricaded Storage

This facility provides field storage for large quantities of explosives in constrained land areas. It is intended for use primarily in austere areas or other locations specifically approved under **AFMAN 91-201**. Modular storage is only approved for certain munitions items such as high explosive bombs, similarly cased Hazard Class/Division (HC/D) 1.1 munitions, 20 mm and 30 mm ammunition in metal shipping containers, and cluster bomb units (CBU) in authorized non-flammable shipping containers per **DoD 6055.9-STD** and **AFMAN 91-201**. The maximum NEW permitted to be stored in each cell is 250,000 lbs (113,636 kg).

4.3.7.1 Facility-Specific Construction Requirements

1. The module is a series of connected cells with hard-surface storage pads separated from each other by barricades. Barricade walls are made of non-fragmenting materials (typically soil with no rocks/debris weighing more than 10 lbs (4.5 kg) or 6 in (152 mm) in diameter).
2. Pad may have non-combustible lightweight shed or roof covering.
3. Pad base may be concrete, asphalt, packed soil, or AM-2 matting.

4.3.7.2 Facility-Specific Spatial Requirements

The size of the module pads is determined by mission needs and available space (relative to meeting Q-D requirements). Refer to Unit Master Storage Plan, **DoD 6055.9-STD** and **AFMAN 91-201** for further guidance.

4.3.7.3 Facility-Specific Mechanical Requirements

Not applicable.

4.3.7.4 Facility-Specific Electrical Requirements

1. Must have a serviceable lightning protection system installed.
2. May require exterior lighting and grounding points, depending on weapons system stored.

4.3.7.5 Other Specific Requirements

Not applicable.

4.3.8 Category Code 422-275 Ancillary Explosives Facility

Figure 4.26
Ancillary Explosives Facility - Munitions Loading/Unloading Dock at Luke AFB, AZ

Facilities in this category code include rail classification yards, secure holding yards, inspection stations, interchange yards, loading docks, ready explosives facilities, and bomb preload stations. These facilities are defined in **AFH 32-1084**. Flight line holding points are not included (listed as category code 422-277).

4.3.8.1 Facility-Specific Construction Requirements

1. Overhead cover may be required to protect personnel from the sun and other elements.
2. Fencing may be required based upon the security requirements outlined in **AFI 31-101**.
3. Ground surfaces may require paving or other hardened surface (AM-2 matting, stone, etc.) as warranted by the traffic volume and gross weight of loaded munitions support equipment.
4. Barricades may be required based upon the location, class and NEW of explosives. Barricade walls are made of non-fragmenting materials (typically soil with no rocks or debris weighing more than 10 lbs (4.5 kg) or 6 in (152 mm) in diameter).
5. Sufficiently sized paved surfaces are required to meet traffic volume and turning radii of handling equipment and vehicles.

Figure 4.27
Ancillary Explosives Facility - MAC Pad at Cannon AFB, NM

4.3.8.2 Facility-Specific Spatial Requirements

1. Installation explosives storage requirements are based on a unit's missions, support, training, weapon bed down plans, and operational plan requirements.
2. Storage requirements above current capabilities should be developed jointly with base safety and engineering offices.
3. Within rail classification, holding, and interchange yards, the length of the rail is dependent upon volume of traffic at the base.
4. Rail tracks should be looped to permit two exit routes.

4.3.8.3 Facility-Specific Mechanical Requirements

May require HVAC for climate control in field offices supporting the assigned functions depending on local climate conditions.

Figure 4.28
Ancillary Explosives Facility - Barksdale AFB, LA

4.3.8.4 Facility-Specific Electrical Requirements

1. Provide grounding, surge protection, and LPS.
2. Rails and related track material that is used in rail classification, holding, and interchange yards must be bonded, grounded, and insulated from the remaining track.
3. May require electrical outlets and interior/exterior lighting as described in **TM 5-811** and **AFMAN 91-201**.
4. Secure holding area lighting must be automatically timed and positioned so as to not expose/silhouette guards. Lighting must extend 25 ft (7.6 m) beyond the perimeter of the holding area. **DoD 4500.9-R Regulation**, *Defense Transportation Regulation (DTR) Part II* contains information on establishing a secure parking area.
5. Secure holding area must have a primary power source and an emergency backup power source that starts up when the primary fails.

4.3.8.5 Other Specific Requirements

1. Explosives safety criteria, Q-D, and storage compatibility groups must be considered for all items. Existing and proposed facilities must be able to store a NEW that meets mission requirements without violating Q-D criteria.

   Q-D criteria does not apply to incoming vehicle and rail inspection stations used solely for inspections, or in interchange yards when the exchange is made and vehicles/railcars are promptly moved.
2. Rail trackage will be of standard gauge, clearance, and weight as required by interstate/host nation regulations. See **AFMAN 32-1125(I)**, *Railroad Design and Rehabilitation* for additional guidance.
3. Rail trackage will connect with the common carrier delivering shipments to the base.
4. Vegetation control is strictly enforced along rail trackage per **AFMAN 91-201**. .
5. Secure holding area requires the following security items. **DoD 4500.9-R Regulation**, *Defense Transportation Regulation (DTR) Part II* contains information on establishing a secure parking area.
   a. Perimeter fencing

b. Access control and a means (barriers) to stop unauthorized entry

c. Security-warning signs posted every 300 ft (91 m)

d. Duress system to notify security forces of unauthorized entry

e. Intrusion detection system or closed circuit television if the guard does not have direct visual observation of the area

6. Preload station (munitions assembly conveyor pad) requires legible on-site safety placarding as per **AFMAN 91-201**.

Basic Design Standards for Munitions Transportation Facilities

- **AFH 32-1084**, *Facility Requirements*
- **AFI 32-1021**, *Planning and Programming Military Construction (MILCON) Projects*
- **AFMAN 91-201**, *Explosives Safety Standards*
- **TM 5-1300/AFM 88-22,** *Structures to Resist the Effects of Accidental Explosives*
- **DoD 5100.76-M**, *Physical Security of Sensitive Conventional Arms, Ammunition and Explosives*
- **AFJMAN 32-8008, Vol 1,** *General Provisions for Airfield/Heliport Pavement Design*
- **DoD 4500.9-R Regulation**, *Defense Transportation Regulation (DTR) Part II*
- **UFC-3-260-01**, *Airfield and Heliport Planning and Design.*
- **Mil HDBK 1013/1A**, *Design Guidelines for Physical Security of Facilities*
- **Technical Order** (T.O.) 11A-1-61-4, and pertinent technical orders of the 11A, 11C, 11G, 11K, 11N, and 11P series.

4.4 Transportation Facilities

Transportation facilities provide for the movement of munitions materials and equipment to meet operating and mission requirements. These facilities include dangerous cargo pads, flight line munitions holding points, primary and alternate munitions movement routes, vehicle parking, and load and unload platforms (railheads).

4.4.1 Category Code 116-662 Pad, Dangerous Cargo

Figure 4.29
Dangerous Cargo Pad - McChord AFB, WA

Dangerous cargo pads are paved areas for loading and unloading explosives and other hazardous cargo from aircraft They are required at facilities where Q-D safety criteria would be violated (in relation to other critical resources) if the existing aprons were used for loading and unloading explosives or dangerous cargo. Do not site explosives or activities involving explosives within the Landing Lane Clear Zone and Accident Potential Zone. For further details, see **UFC 3-260-01**, *Airfield and Heliport Planning and Design,* **AFI 32-7063**, *Air Installation Compatibility Use Zone Program,* and **AFH 32-7084**, *AICUZ Program Manager's Guide*.

Paved shoulders are provided around the perimeter of an apron to protect adjacent areas from jet blast, help mitigate foreign object damage (FOD), provide structural support for blast deflectors, permit equipment storage, and to facilitate drainage. Criteria for apron shoulders are presented in **UFC 3-260-01** for fixed-wing aircraft, and **AFH 32-1084** for rotary-wing aircraft. The surface adjacent to the paved shoulder should be graded to facilitate drainage and to prevent storm water from ponding on the outside edge of the shoulder.

4.4.1.1 Facility-Specific Construction Requirements

1. Access road surfaces should be constructed of concrete.
2. An access taxiway connecting the pad to a taxiway is required. Medium-load pavement designed to accommodate airlift aircraft should be installed for the pad and access taxiway.
3. Provide a revetment when required by Q-D criteria.
4. Provide a means to post applicable explosives safety fire/hazard symbols.

Figure 4.30
Dangerous Cargo Pad - Langley AFB, VA

4.4.1.2 Facility-Specific Space Requirements

A paved roadway to the hazardous cargo pad for access by trucks and other vehicles should be provided.

1. The location of the pad must comply with the criteria outlined in **UFC 3-260-01**, **DoD 6055.9-STD**, and **AFMAN 91-201**. The effects of jet blast turbulence and temperature should be considered during the siting and design processes.
2. A circular pad with a 110 ft (33.5 m) radius and 4,225 sq yd (3,530 m^2) is authorized for installations other than Aerial Ports of Embarkation/Debarkation (APOE/APOD).
3. APOE/APODs that store or process in-transit explosives require two pads to accommodate C-141, C-5, C-17, and Boeing 747

aircraft. Additional pads are required where there is an unusually high volume of activity. Design details are:

a. A semicircular pad is needed by large cargo aircraft up to and including the dimensions of the C-5.

b. The space requirement for each pad is about 8,900 sq yd (7,440 m^2). The siting and configuration of the pads is based on 30,000 lb (13,600 kg) of NEW HC/D 1.1..

4. Hazardous cargo pads may be larger than these dimensions if the design aircraft cannot maneuver on the pad. Sources for obtaining information concerning minimum turning radii for various aircraft is presented in Army **ETL 1110-3-394**, *Aircraft Characteristics for Airfield-Heliport Design and Evaluation*.

5. Paved shoulders should be a minimum 10 ft (3.1 m) wide with lights installed. Wider shoulders are required for wide-bodied aircraft. Shoulders provide locations for lighting and control of FOD.

6. Aprons should be sized to allow safe movement of aircraft under their own power and must provide sufficient space for parking fixed- and rotary-wing aircraft.

4.4.1.3 Facility-Specific Mechanical Requirements

Storm water runoff collection system including inlets, trench drains, manholes, and pipe should be provided. This system shall direct flows to a collection system to ensure flows do not impact airfield operations.

4.4.1.4 Facility-Specific Electrical Requirements

1. Telephone service, apron lighting, and airfield lighting are required for safety.

2. Apron edge lighting and airfield lighting must be blue, flush type taxiway lights around the edge of the pads in accordance with **AFI 32-1044**, *Visual Air Navigation Systems* and **AFMAN 32-1076**, *Design Standards for Visual Air Navigation Facilities*.

3. Grounding points must be provided on each hazardous cargo pad for aircraft and munitions materiel handling equipment (MMHE) grounding. These points are detailed in **UFC 3-260-01**.

4.4.1.5 Other Special Requirements

1. Tie-down/mooring points/tie-down mooring eyes must be provided on each hazardous cargo pad. These points are detailed in **UFC 3-260-01**.

2. Water/hydrants for firefighting will be included to serve the pad(s).

Figure 4.31
Munitions Holding Point - Luke AFB, AZ

4.4.2 Category Code 422-277 Munitions Holding Point

The procedures for delivering munitions from the MSA to the aircraft vary based upon local and mission requirements. One option is direct delivery from the MSA to the flightline. The other option that can be selected by the Equipment Maintenance or Munitions Squadron Commander is to use a two-stage delivery process where a minimum amount of assembled munitions (usually one day's requirement) are temporarily moved to a flight line munitions holding point (also known as a holding area munitions (HAMS) yard) delivery to the operational aircraft or subsequent return to the MSA.

4.4.2.1 Facility-Specific Construction Requirements

1. Provide paved roadways to the holding point gates for access of munitions handling equipment. Pavement used for access drives and aprons shall support the weight of munitions handling equipment and will not contribute to foreign object damage on the flight line. May be made of concrete, asphalt, or AM-2 matting.
2. The entire holding point shall be fenced and meet security requirements in **AFI 31-101**.
3. Provide a revetment when required by Q-D criteria.

Figure 4.32
Munitions Holding Point - McChord AFB, WA

4.4.2.2 Facility-Specific Spatial Requirements

1. The types and quantities of munitions, along with maneuver room for munitions handling support equipment, dictate the space requirement for the holding point.
2. The number of personnel assigned determines the size of the personnel shelter. A common size is 250 sq ft (23 m^2).
3. Install an electrical motor-driven main vehicle access gate that is remotely controlled from the personnel shelter.
4. Install a second, manually operated, vehicle access gate to provide drive-through capability.
5. This shelter must have a bay window overlooking the holding pad and main entry gate.
6. The location of the pad must comply with the criteria outlined in **UFC 3-260-01**, **DoD 6055.9-STD**, and **AFMAN 91-201**. The effects of jet blast turbulence and temperature should be considered during the siting and design processes.

4.4.2.3 Facility-Specific Mechanical Requirements

Chapter 3, "General Design Guidance" contains basic criteria for the personnel shelter mechanical requirements (as dictated by climatic conditions).

Figure 4.33
Munitions Holding Point - Luke AFB, AZ

4.4.2.4 Facility-Specific Electrical Requirements

1. Provide illumination on the holding point pad for night operations, as required.
2. Lightning protection will be installed per **NFPA 780**, **DoD 6055.9-STD**, and **AFMAN 91-201** unless the lightning protection system interferes with safety-of-flight operations.
3. Grounding points must be provided in sufficient quantities for units using ammunition-loading systems. Install grounding systems as per **AFI 32-1065**.
4. Use **AFMAN 91-201** to determine the required separation of electrical utilities (e.g., lines, transformers) from the holding point based upon the amount of voltage and whether the utilities are aboveground or below ground.
5. Use Chapter 3, "General Design Guidance" for the personnel shelter electrical requirements.

4.4.2.5 Other Specific Requirements

Provide a means to mount first aid fire extinguishers in the holding point area.

4.4.3
Category Code 851-147
Explosives Movement Routes

Figure 4.34
Explosives Movement Route - Langley AFB, VA

These are primary and alternate routes used to transport explosives from one location on an installation to another. Although design criteria for Real Property Category Group 85 is generally applicable to all roads and streets on the installation, the primary purpose of this section is to assist in the selection and location of explosives movement routes.

Vehicle traffic volume, range of vehicular loads (weight), and mix of vehicles determines the dimensional requirements for roads. Additional information on road requirements can be found in **AFH 32-1084** and in **AFMAN 91-201**. Curbs and gutters will not be provided in isolated areas (such as MSA, bulk fuel storage areas) or open storage and other facilities far removed from the main part of the base (unless required for stormwater control).

Figure 4.35
Explosives Movement Route - Barksdale AFB, LA

The safest primary and alternate explosives movement routes should be designated to cover each delivery route (delivery to MSA, delivery from MSA, delivery from MSA to flightline, etc.). The Base General Plan may aid in identifying these routes and explain any limitations on explosives quantities by HC/D. Routes near mission-oriented facilities, in areas that are densely populated, experience high-traffic volumes, or that pass through areas where schools, child development centers, youth centers, hospitals, recreational, or commercial areas are located, should be avoided. The routes should be confined to secondary roads where possible so that in the event of a mishap, the surrounding area may be evacuated. Roads should be of adequate geometry (e.g., turning radius) and structured to accommodate the MMHE and related explosives support vehicles. Roads and streets should also be able to support the typical loaded MMHE and vehicle weights associated with explosives movements.

The movement of munitions within a MSA to and from licensed storage locations, and transportation of explosives in support of training working dogs is not restricted to designated routes per **AFMAN 91-201**. Q-D criteria does not apply to munitions and explosives while being transported; however, precautions should be taken to ensure minimum exposure of people and property during all phases of transportation. The amount of time munitions and explosives are in the transportation mode must be limited to the minimum amount necessary to complete the task.

The transfer of explosives and munitions from storage areas to and from arm/disarm pads should occur on dedicated transfer roads. Where possible, transfer roads should be used exclusively for explosives and munitions transfer vehicles per **UFC 3-260-01**.

4.4.4 Category Code 852-261 Vehicle Parking

Figure 4.36
Government Equipment Parking -
Langley AFB, VA

This Cat Code applies to parking for government owned vehicles (GOV). For cold weather climates, Vehicle Operations Heated Parking(Category Code 214-426), IAW **AFH 32-1084** may be authorized.

Vehicular parking areas for munitions facilities are generally located adjacent to an activity whose function requires 24-hour access to a substantial number of its assigned vehicles. These areas are known as "subpools." Authorization for subpool areas must be obtained from the transportation office and may include any parking space not identified by other real property category codes

Munitions GOV subpools require a paved or stabilized surface. Subpools may require floodlighting, a security fence at least 6 ft (1.8 m) high, and one or more controlled paved entrances when the operation presents a special need for safeguarding and night lighting.

Figure 4.37
Vehicle Parking -
Barksdale AFB, LA

Guidance for authorized vehicle operations subpools should follow in accordance with **AFMAN 32-1084**. Refer to Table 4.1, "Parking Space Requirements for Vehicle Operations Parking", for additional vehicle parking space requirements.

4.4.4.1 Facility-Specific Construction Requirements

1. A paved or stabilized surface (e.g., concrete, asphalt, AM-2 matting, or packed stone, etc.) is required.
2. GOV and powered munitions trailer-parking areas should be located at least 100 ft (30 m) or intraline separation distance from explosives locations, unlike other motor pools, which require inhabited building separation distances. The installations fire marshal and WSM may reduce these parking requirements for explosives licensed locations.

4.4.4.2 Facility-Specific Spatial Requirements

1. For additional GOV parking space guidance, refer to Aircraft Support Equipment Storage Yard (Category Code 852-273) and Non-Organizational Vehicle Parking (Category Code 852-262) in **AFH 32-1084**.
2. Table 4.1 provides specific requirements to calculate the areas authorized for vehicle operations subpool parking. However, Table 4.1 does not take into account oversized and outsized vehicles and may require adjustments to meet circumstances at individual locations.

4.4.4.3 Facility-Specific Electrical Requirements

1. Areas may require floodlighting for security reasons or to meet the operational mission.
2. Provide exterior type electrical outlets at installations having severe winters to power vehicle engine heating devices.

4.4.4.4 Other Specific Requirements

1. Vehicle parking areas require paved or stabilized surface and should be well-drained to avoid standing water.
2. Areas should be enclosed with a 6 ft (1.8 m) fence, if not already cantoned.
3. Provide wash rack including steam cleaning equipment for every 25 vehicles assigned.

Figure 4.38
Government Equipment Parking -
Luke AFB, AZ

Vehicle Space Factors	Gross Area	
	m^2	sq yd
50-100	3,180	3,800
101-150	4,870	5,825
151-250	8,110	9,700
251-350	11,400	13,600
351-450	14,600	17,500
451-650	21,100	25,250
651-850	27,200	32,500
851-1000	34,700	41,500

Table 4-1
Parking Space Requirements for Vehicle Operations Parking
(Source: AFH 32-1084)

4.4.5 Category Code 890-158 Load and Unload Platform (Railhead)

Railroad trackage includes sidings, spurs, and tracks. Railroad construction should comply with guidelines found in **AFJMAN 32-1048**, *Railroad Track Standards* and **AFMAN 32-1125(I)**, *Railroad Design and Rehabilitation*. Guidelines for trackage are found in **AFH 32-1084**. Construction of new rail facilities, or designation of existing rail facilities for the purpose of munitions movements, inspection, or holding must comply with the explosives safety guidelines found in **AFMAN 91-201**. For information on railway construction and maintenance, refer to **American Railway Engineering and Maintenance-of-Way Association (AREMA)**.

4.4.5.1 Facility-Specific Construction Requirements

1 Provide paved or stabilized surface (e.g., concrete, asphalt, AM-2 matting, or packed stone, etc.) for use by MMHE and other munitions support vehicles.

2 Access road, if required, should be constructed to accommodate the weight and turning radii of MMHE.

3 Railhead must have a loading ramp constructed of sufficient size to accommodate MMHE and rolling stock.

4.4.5.2 Facility-Specific Spatial Requirements

Land area for rail yards should be sufficient to ensure explosives-loaded vehicles/railcars are separated from each other by the applicable (based on NEW and type) above-ground magazine distance. If the above-ground magazine distance between vehicles/railcars cannot be met, vehicles/railcars should be parked in groups, with the above-ground magazine separation between each group. Separation distances to other exposures (facilities or uses) should then be based on the total amount of explosives within a group of vehicles/railcars.

4.4.5.3 Facility-Specific Mechanical Requirements

If authorized, a stand-alone weather shelter not to exceed 250 SF (16 m^2) will be provided for protection from the elements. Provide potable water, bathroom, sanitary sewer, and HVAC systems for the shelter.

4.4.5.4 Facility-Specific Electrical Requirements

1. Provide electrical system to support weather shelter.
2. Rails and related track material must be bonded, grounded, and insulated from the other railroad track on base.
3. Provide LPS.
4. As applicable, provide adequate lighting to meet local operational and security requirements.

4.4.5.5 Other Specific Requirements

1. Rail trackage will be of standard gauge, clearance, and weight as required by interstate/host nation regulations. See **AFMAN 32-1125(I)** for additional guidance.
2. If not within the confines of a controlled area (i.e, within the MSA), provide an enclosed area with a 6 ft (1.83 m) fence and control entry gate(s) to meet base security requirements.
3. Trackage layout should be looped to allow two ways of exit.
4. Intraline Q-D separation applies to all transfer operations involving explosives except for, roll-on/roll-off operations (not involving lifting) and off-installation military van/**International Organization for Standardization** (MILVAN/ISO) container inter-/intramodal transfers, including Trailer on Flat Cars (TOFC). This applies if containers are not stored or other operations are performed. Q-D separation is not required for these operations. The base WSM will determine the specific rules for operations at these types of operations.
5. Railheads for explosives-laden railcars should be located away from hazardous areas such as other explosives sites, Petroleum Oil Lubrication (POL) sites, populated areas, and flight lines. The area should be cantoned, with adequate Q-D standoff distances from public thoroughfares or boundary fences.

Basic Design Standards for Munitions Administration Facilities

- **AFH 32-1084**, *Facility Requirements*
- **AFI 32-1021**, *Planning and Programming Military Construction (MILCON) Projects*
- **AFMAN 91-201**, *Explosives Safety Standards*
- **TM 5-1300/AFM 88-22,** *Structures to Resist the Effects of Accidental Explosives*
- **DoD 5100.76-M**, *Physical Security of Sensitive Conventional Arms, Ammunition and Explosives*
- **DoD 6055.9-STD**, *Ammunition and Explosives Safety Standard*
- **Mil HDBK 1013/1A**, *Design Guidelines for Physical Security of Facilities*
- **AFI 21-201**, *Management and Maintenance of Non-Nuclear Munitions*
- **AFI 31-101**, The Air Force Installation Security Program (FOUO)

4.5 Munitions Administration Facilities

Administration facilities provide for the administrative affairs of the munitions community. For the purpose of this standard, administration facilities also house Line Delivery and Storage dispatch functions. The type of construction for administration facilities varies depending on local architectural standards. When siting the munitions administration facility, proximity to the primary work locations within the MSA should be considered to enhance productivity. Consult the Base Architectural Design Guide for additional guidance.

4.5.1 Category Code 610-144 Munitions Administration Facility

Figure 4.39
Munitions Administration Facility -
Luke AFB, AZ

These facilities house several functions including munitions operations, Combat Ammunition System (CAS), munitions control, flight/squadron leadership, dispatch, training, etc.

4.5.1.1 Facility-Specific Construction Requirements

1. Threat analysis may dictate using semi-hardened, splinter-protected, or hardened construction criteria.
2. Facilities housing the munitions control function must meet the following requirements:
    a. Controlled Area construction criteria outlined in **AFI 31-101**.
    b. Solid wood or metal door with a mechanical or electrical lock and peephole or video monitoring device.
    c. Floors covered with industrial grade carpeting, floor able to support the weight of safes.
    d. Room completely enclosed as required in **AFI 21-201**, *Management and Maintenance of Non-Nuclear Munitions.*

4.5.1.2 Facility-Specific Space Requirements

Figure 4.40
Munitions Administration Facility -
Cannon AFB, NM

1. Use the Unit Personnel Management Roster to help determine the number of personnel to be located in the facility. Using guidance provided in **AFH 32-1084**, facility planners and designers should consider the types and numbers of building occupants and design for the types of activities within the facility.
2. The building gross floor area should not exceed 162 SF (15 m²) per person, plus authorized special purpose space. Refer to Table 4.2, "Munitions Squadron Administration Building" and Table 4.3, "Munitions Flight Administration Building Area Allocations" of this standard for size information on the average facility. Room sizes should be adjusted based on mission requirements.
3. A training area must be provided to support the Combat Munitions Training Program. Size of the classroom is based upon student throughput and space required for training aids.

4.5.1.3 Facility-Specific Mechanical Requirements

The facility shall be air-conditioned. HVAC requirements will be as prescribed by the applicable industry standard. HVAC requirements for

administrative areas must comply with requirements defined in Chapter 3, "General Design Guidance".

4.5.1.4 Facility-Specific Electrical Requirements

1 A non-interruptible power supply is necessary to maintain operational capability.

2 Munitions Control requires sufficient 110 VAC power outlets to support radio base stations, status boards, computer systems, battery chargers, and other equipment as described in **TM 5-811** and **AFMAN 91-201**. Munitions Control also needs standby and emergency power.

3 An LPS and surge protection is required.

Figure 4.41
Munitions Administration Facility -
McChord AFB, WA

4.5.1.5 Other Specific Requirements

Munitions Control requires: secure voice communications capability; two dedicated land mobile radio networks; dedicated phone lines to Explosives Ordnance Disposal, Fire Department, Security Forces, Command Post, Maintenance Operations Center, and all munitions work centers; and a local area network to operate Munitions Control 2000.

Functions	Net Area	
	m^2	sq ft
Squadron Commander	19	200
Commander's Secretary	11	120
First Sergeant	11	120
Section Commander	14	150
Orderly Room (6 people)	66	720
Safety/Quality Assurance (4 people)	44	480
Vehicle Control Officer	11	120
Resource Advisor	11	120
Maintenance Supervisor	14	150
Maintenance Superintendent	11	120
Subtotal	**212**	**2,300**
Circulation and Walls (15%)	25	272
Gross Total (MUNS Squadron Administration)	**237**	**2,572**
The Munitions Control and Training functions may reside in the squadron administrative building.		

Table 4-2
Munitions Squadron Administration Building (See Note)

Functions	Net Area	
	m^2	sq ft
Flight Commander, Flight Supervisor, or Munitions Accountable Systems Officer (MASO)	14	150
Superintendent (Flight, Production, Systems, or Materiel)	11	120
Inventory Control -- CAS (4 people) (Adjust proportionally for each shift if element contains more personnel.)	44	480
Administration (4 people)	44	480
Conference Room (30 people)	49	525
Munitions Control (4 people) (Adjust proportionally for each shift if element contains more personnel.)	44	480
Weapons Vault	14	150
Facilities Management	11	120
Training Office	11	120
Vehicle Control NCO	11	120
Safety/QA	11	120
Training Rooms (2 for 30 people each)	84	900
Library	21	225
Break Areas	19	200
Restroom, Locker Room, Showers	47	500
Janitor Closets	5	50
Mechanical Room (verify with geographic location)	28	300
Subtotal	**468**	**5,040**
Circulation and Walls (15%)	67	718
Gross Total (MUNS Flight)	**535**	**5,750**

Table 4-3
Munitions Flight Administration Building Area Allocations